YOUR SOURCE OF ENERGY

Missouri Department of Natural Resources

GRADE LEVEL:
Upper Middle School to High School

SUBJECT AREA:
Sciences, Math

DURATION:
Preparation time: 15 minutes
Activity time:
Part 1-one 50-minute class session
Part 2-one 50-minute class session

SETTING:
Classroom

SKILLS:
Application, Analysis, Synthesis

KEY WORDS:
Infrastructure, Photosynthesis, Respiration, Consumers, and Combustion

CORRELATION'S TO SHOW-ME STANDARDS:
Performance standards
1.6, 1.10, 2.3 3.2
Knowledge Standards
SC-1,2,3,4,5,6,8
M-1

SUMMARY

In the first part of this activity students will explore the role the sun plays in providing much of the earth's energy. The second part of the activity asks the students to locate the commercial energy production facilities nearest their school and explore the energy transmission and transportation systems surrounding them.

OBJECTIVES

PART 1:

PHOTOSYNTHESIS

THE STUDENTS WILL:

- ✓ Explore the role the sun plays in providing energy to all life forms on earth
- ✓ Make connections between the energy from the sun and the energy in the food they eat
- ✓ Make connections between the energy from the sun and other forms of energy they use in their daily lives

PART II:

ENERGY INFRASTRUCTURE

THE STUDENTS WILL:

- ✓ Locate the various energy production facilities near their school
- ✓ Explore how their energy is produced and determine the proximity of this infrastructure to their location
- ✓ Explore the energy transmission systems that deliver the energy used by their school
- ✓ Consider the impacts on daily life if easy access to energy is interrupted

MATERIALS

- Diagram of the carbon cycle
- Copy of the maps of energy production facilities found in Missouri

BACKGROUND

PART 1:

PHOTOSYNTHESIS

The sun provides the vast majority of the energy that exists on our planet. Without the Sun's energy most forms of life on earth could not exist. Plants depend on a chemical process called photosynthesis (see below).

$CO_2 + H_2O \rightarrow$ Plant Tissue + O_2

This reaction is driven by the energy found in sunlight and allows plants to build complex chemical structures, construct tissue and carry out their life processes.

The plants in turn serve as food for other organisms (consumers). These consumers gain energy and the raw materials for building body tissue, by feeding on plants directly, or by consuming other animals that eat plants. Consumers gain energy by essentially reversing the photosynthetic process (see hand out attached to this lesson for a suggested way to demonstrate this principle to students).

More information can be found in the Forms of Energy section in the general background section of the energy curriculum.

The other forms of energy we use on a daily basis are also derived from the energy in sunlight. Wood, coal, gasoline and natural gas are all products of recent or ancient decayed plant matter and therefore are the result of photosynthesis. When these substances are "burned" the chemical bonds are broken in a process called *combustion,* yielding energy in the form of both heat and light.

The hydrologic cycle is also driven by the sun's energy, resulting in evaporation and precipitation. This process constantly renews the flow of river systems and can be used to generate hydroelectric power.

Similarly, wind is a result of the uneven heating of the earth's surface by sunlight. The wind holds great potential to be harnessed for energy production.

More information on specific types of energy systems can be found in the general background section of the energy curriculum.

Part II:

ENERGY INFRASTRUCTURE

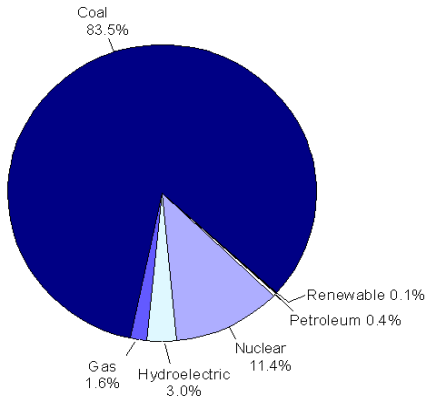
With the advent of the modern industrial age we now have access to complex forms of energy on a daily basis. Easily obtained energy is used to heat and cool our homes, provide light indoors and at night, and power most of our technology-based tools. Currently more than 35 percent of all energy consumed in the United States is used to generate electricity. In most cases electricity is generated by converting other forms of energy to heat, and the heat is then used to convert water into steam. The rapidly expanding steam is used to force large turbine systems to rotate. These turbines contain large magnetic fields and an electrical current is generated.

Electrical power is typically produced by a large power plant and then distributed to individual homes and buildings through a transmission system. Typically the electricity is "stepped up" to a higher voltage using transformers

prior to distribution to regional communities using large high-tension wires. Before entering a home or business this high voltage electricity is reduced to a lower voltage using a "step-down" station. These can often be seen in your community and consist of a series of transformers enclosed in a high-fenced compound. The resulting lower voltage is distributed to your neighborhood using overhead wires or underground cable systems.

A profile of power sources used for generating electrical power in Missouri is presented below.

ELECTRICITY PRODUCED IN MISSOURI BY SOURCE-U.S. DEPARTMENT OF ENERGY



PRIMARY SOURCES FOR ELECTRICAL POWER PRODUCTION-MISSOURI (Source: EIA)

In addition to electrical power, another common source of on-demand energy is natural gas or propane. Many homes use gas-fired furnaces for heating and cooking needs. A national distribution network is used to transport natural gas, and many of these pipes run right though Missouri.

Currently 93.4 percent of the energy needs of Missouri are provided by fossil fuels, with the vast majority of these being imported.

PROCEDURE

WARM UP

Set the stage by asking the students:

- *Where does the earth's energy come from?*
- *What form of energy do the students use most in their home?*
- *Where is the source of the energy used in their home?*

Part I

Review the carbon cycle diagram included with this lesson. Discuss the reversible nature of chemical reaction (see demonstration activity attached).

Ask the students to create an energy flow chart or poster, indicating the all the steps involving energy, required to produce a bowl of milk and cereal.

For example: The milk comes from a cow…what did the cow eat?…where did this food come from and how was it produced?…how was the cow milked?…how was the milk packaged and transported?.

The students should be able to trace most of the energy used to generate a bowl of milk and cereal back to energy from the sun

Part II

Review with the students the sources of energy, and how such energy is delivered to our homes, schools and businesses. Show the students the maps depicting the major energy systems present in Missouri.

Have the students locate several of the nearest power plants.

Ask the student to consider how the materials used to generate power (coal, natural gas and petroleum) are brought into the state.

Have the students locate parts of the national energy infrastructure that are used in import energy related

fuels into the state of Missouri.

Does the school use natural gas? Where does this line come into the school? (Look for a meter and above ground pressure regulator hooked-up to the building)

Discuss with the students the source of fuels Missouri imports (see Fossil Fuel section of the curriculum background).

Ask the students to think of the location of the nearest step-down transformer station. Are the low voltage transmission lines in their neighborhood above ground or buried?

Challenge the students to consider what it would be like if the power was turned off for a week.

- *What problems would result? (Waste treatment plants shut-down, patients at hospitals, deaths due to heat or cold, etc)*
- *Would anyone be in trouble without this energy source (elderly, medically dependent, etc)?*

EXTENSIONS

The maps of Missouri energy facilities represents a simplistic example of the use of an emerging technology referred to as Geographical Information Systems (abbreviated GIS). Such programs use computers to layer information in a graphical format that allows data sets to be interpreted in a much more intuitive manner. The map of Missouri energy facilities represents a better picture of Missouri's energy production than that conveyed by a series of numbers and locations on a spreadsheet. GIS is now being used for a growing range of applications ranging from finding the best location for a new store to analyzing environmental damage following a fuel spill.

The following Web page allows the user to create maps of Missouri based on layers of information the user selects.

http://www.cares.missouri.edu/

DEMONSTRATION ACTIVITY: GAINING ENERGY BY REVERSING CHEMICAL REACTIONS

This short activity demonstrates the reversible nature of chemical reactions and the law of energy conservation (energy cannot be created or destroyed).

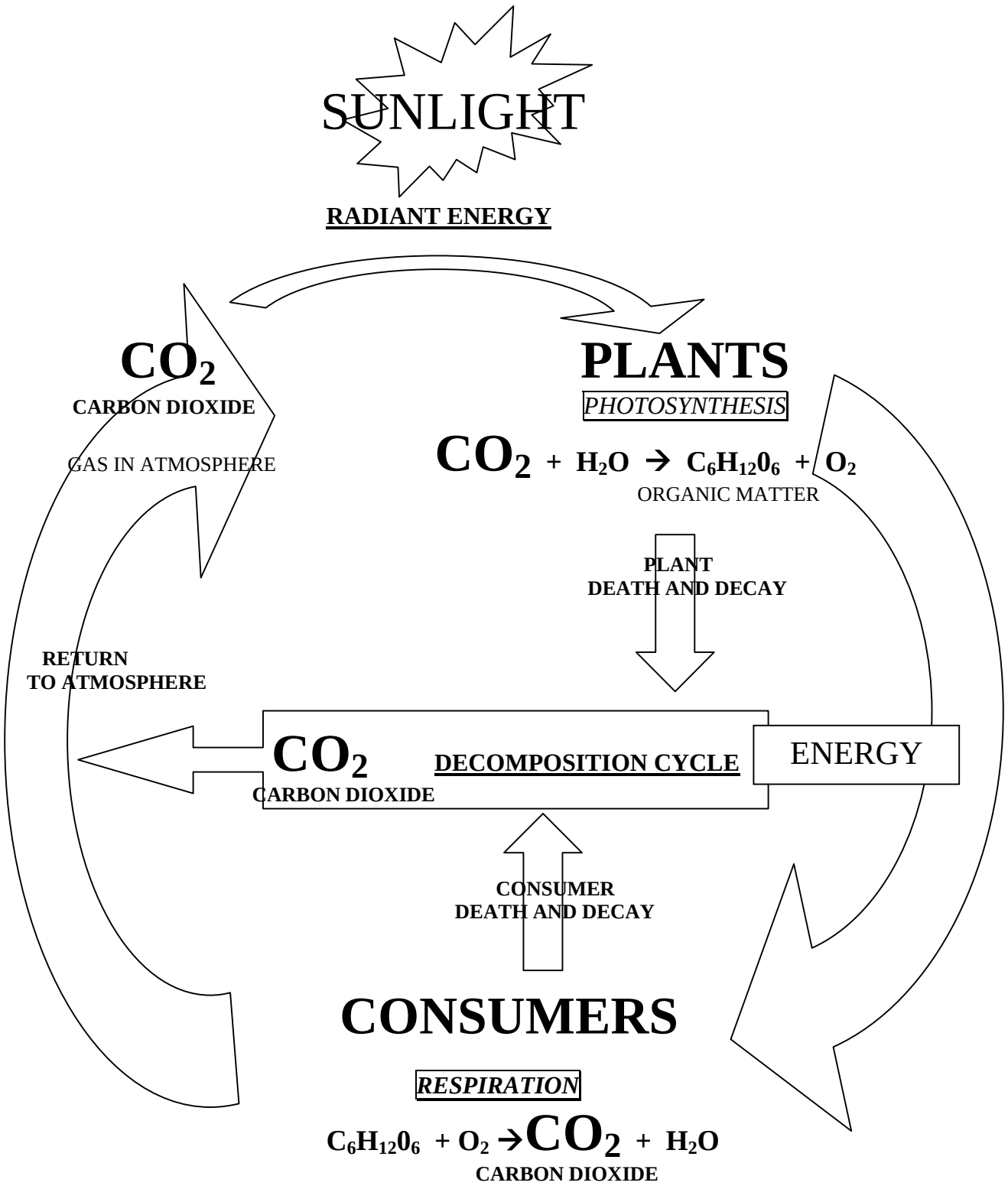
Mark two spots (A and B) on the floor about 10 feet apart. Have two students begin to slowly walk from point A towards B (these two students represent two atoms that are participating in a chemical reaction). As they walk instruct another student, who represents *energy*, to link elbows with each of the two "atoms" thus joining them with a chemical bond. When they reach spot B…discuss how the two atoms have joined (formed a chemical bond) with the help of the *energy* student **(an energy input)**.

Now ask these students to slowly reverse the whole reaction…as they walk backwards…the *energy* student should let go of the two atoms (students) and takes a step away from the reaction letting the "atoms" separate. Discuss with student, that in order to reverse the reaction *energy* had to leave the reaction **(energy was released).**

Summary: Energy that was required to conduct the reaction in one direction was given off when the reaction was reversed. Plants use the sun's energy to build molecules in a process called photosynthesis. When we eat a plant and break the plant molecules back apart (respiration) then energy is produced. All life depends on the plants and gains energy by reversing the reactions of photosynthesis (see diagram to right).

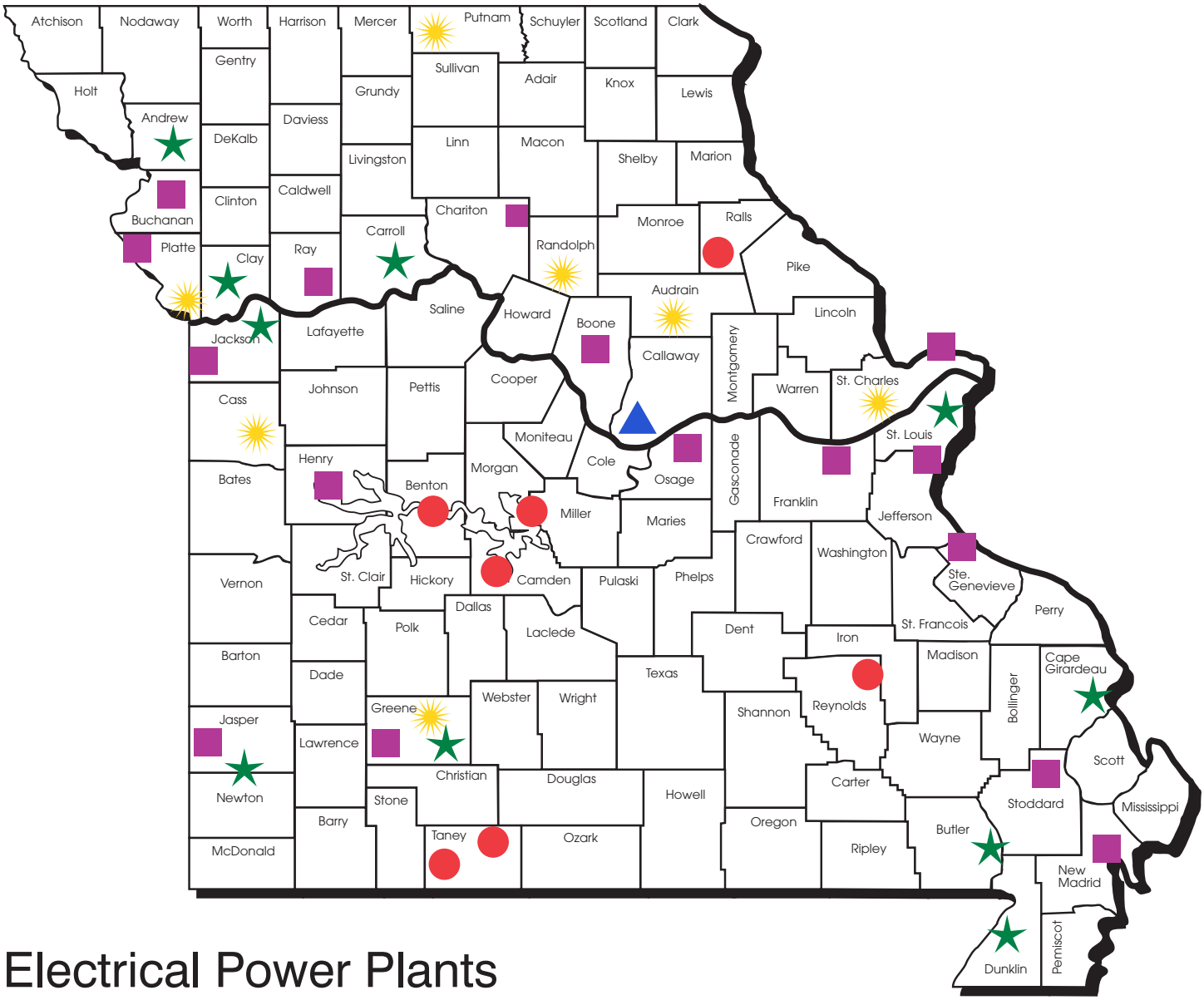
But, what if you eat meat…such as from a cow?

Remember that the cow built itself from eating plants so you are still gaining energy that originally came from the sun.


SUNLIGHT
RADIANT ENERGY
CO_2
CARBON DIOXIDE
GAS IN ATMOSPHERE
PLANTS
PHOTOSYNTHESIS
$CO_2 + H_2O \rightarrow C_6H_{12}0_6 + O_2$
ORGANIC MATTER
PLANT
DEATH AND DECAY
RETURN
TO ATMOSPHERE
CO_2
CARBON DIOXIDE
DECOMPOSITION CYCLE
ENERGY
CONSUMER
DEATH AND DECAY
CONSUMERS
RESPIRATION
$C_6H_{12}0_6 + O_2 \rightarrow CO_2 + H_2O$
CARBON DIOXIDE

Energy for Missouri: Today and Tomorrow

Missouri's Electrical Power Generation System



Electrical Power Plants

- Coal (over 100 mega watts)
- Hydropower (over 10 mega watts)
- Nuclear power
- Natural Gas (over 10 mega watts)
- Fuel Oil

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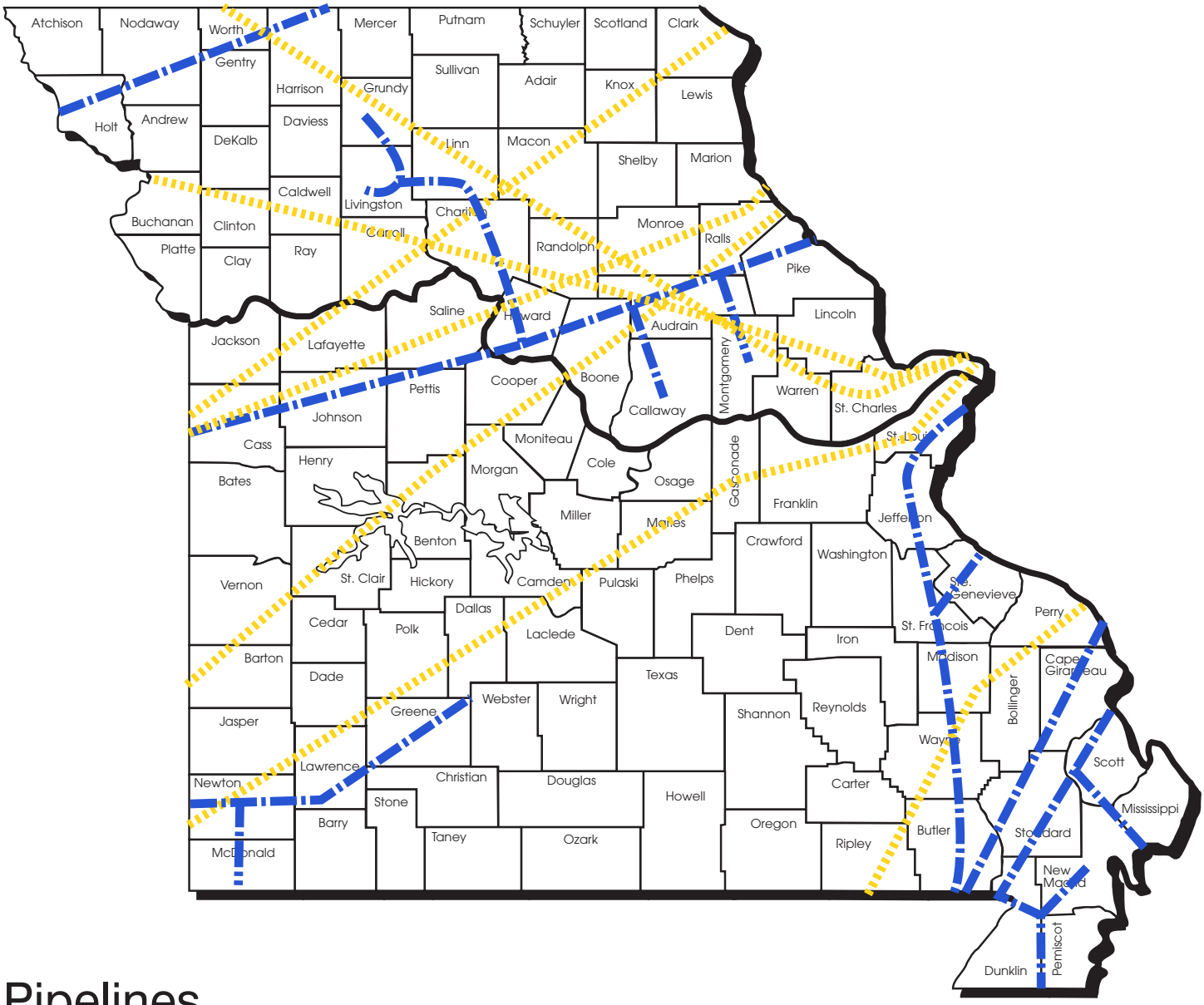
Locations depicted on maps are general area only

9/03

Energy for Missouri: Today and Tomorrow

Oil and Gas Distribution Across Missouri



Pipelines

Crude Oil Pipeline

Natural Gas Pipeline

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